

A Description of the Passage of the Shadow of the MOON, over ENGLAND,  
*In the Total Eclipse of the SUN, on the 22<sup>d</sup> Day of April 1715 in the Morning.*

# Early 18<sup>th</sup>-Century Maps of Solar Eclipse Paths

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## Summary of the slides on the following presentation

The earliest eclipse maps, i.e. maps that depict the path of totality of a solar eclipse across the Earth's surface, are usually attributed to the English astronomer Edmond Halley (1656-1742).

There is ample evidence that Halley was an innovative scientist with an interest in mapping problems. Notable examples are his charts of the Atlantic Ocean (published in 1701) and the Indian/Pacific Oceans (1702) which delineate the compass variation.

However, this presentation will show several examples of earlier eclipse maps designed by French, Dutch and German astronomer-cartographers.

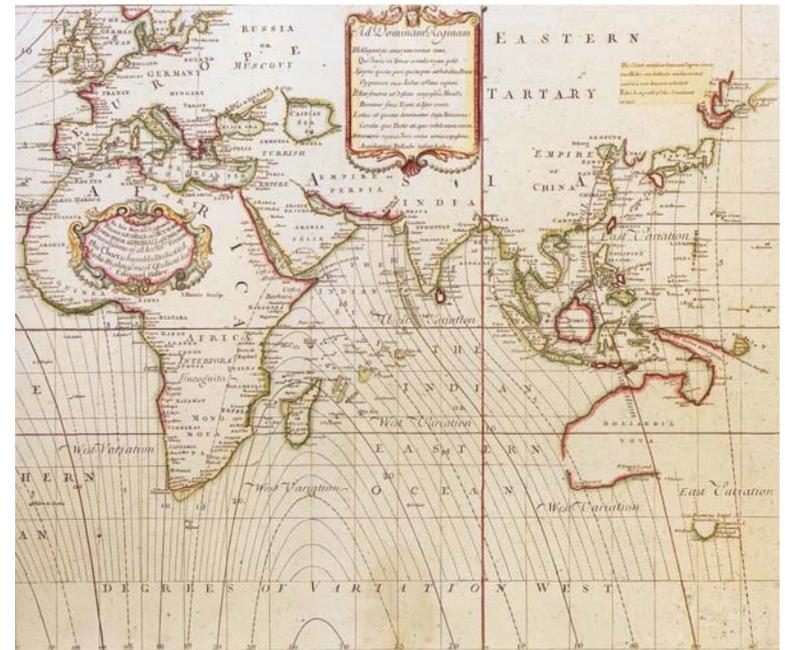
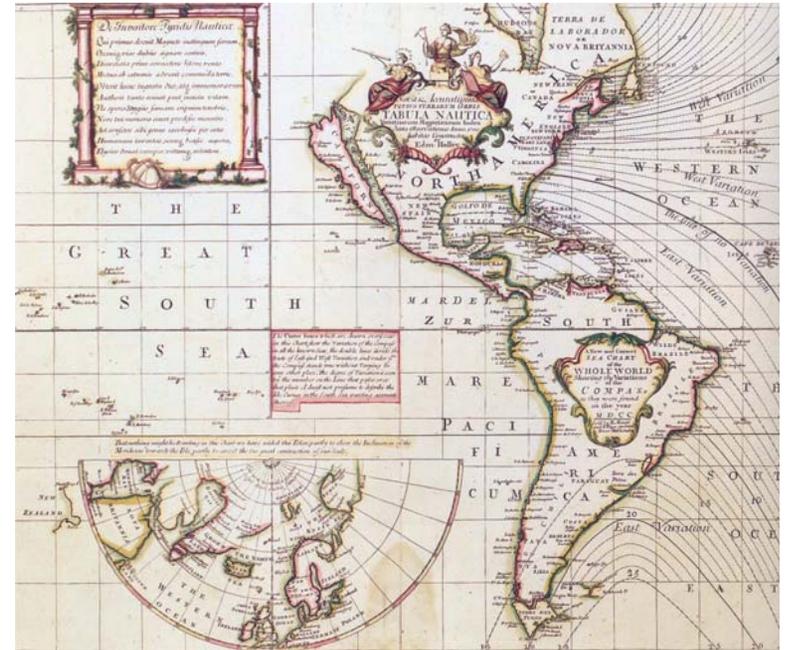
The earliest eclipse map appears to have been published in 1700 by the French astronomer Jean-Dominique Cassini (1625-1712), depicting the path of the solar eclipse of 23 September 1699. Later sources claim that Cassini also produced a map of a solar eclipse in 1664 (or 1661) but efforts to verify this have been unsuccessful.

The next solar eclipse that was visible from Europe, the total solar eclipse of 12 May 1706, was the subject of several eclipse maps drawn by Dutch and German astronomer-cartographers.

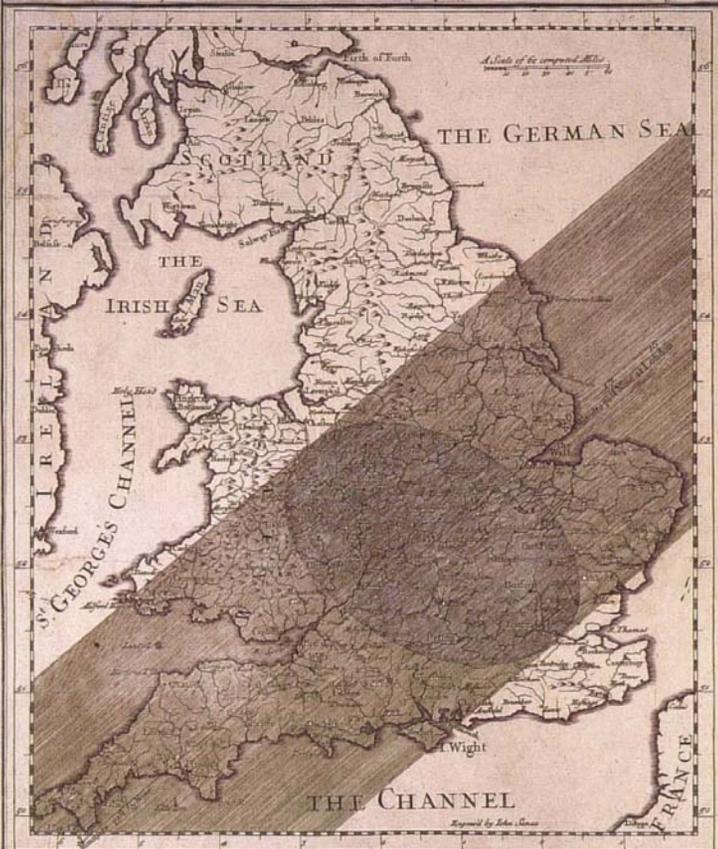
The last slides of this presentation show some examples of later eclipse maps.



**Edmund Halley (1656-1742) and his isoline maps of the magnetic deviation (1701/02)**



A Description of the Passage of the Shadow of the Moon, over England, In the Total Eclipse of the SUN, on the 22<sup>d</sup> Day of April 1715 in the Morning.



The like Eclipse having not for many Ages been seen in the Southern Parts of Great Britain, I thought it not improper to give the Publick an Account thereof, that the sudden darkness when the Sun will be visible about the Sun, may give us some ground to the People, who would, if undisturb'd, be apt to look upon it as Ominous, and to interpret it as portending evil to our King and Country. King George and his Government which they observe. Surely they will see that there is nothing in it more than a Natural, and necessary result of the Motion of the Sun and Moon, and how well these are understood will appear by this Eclipse.

According to what has been formerly Observed, compar'd with our best Tables we conclude the Center of the Moon's Shade will be very nearly Lizard point, when it is about 5 miles past Nine at London, and that from thence in Eleven minutes of Time it will cross the whole Kingdom, passing by Plymouth, Bristol, Gloucester, Downport, Peterborough, Boston, near the small part of Island. On each side of the Strait for about 2 Miles the Sun

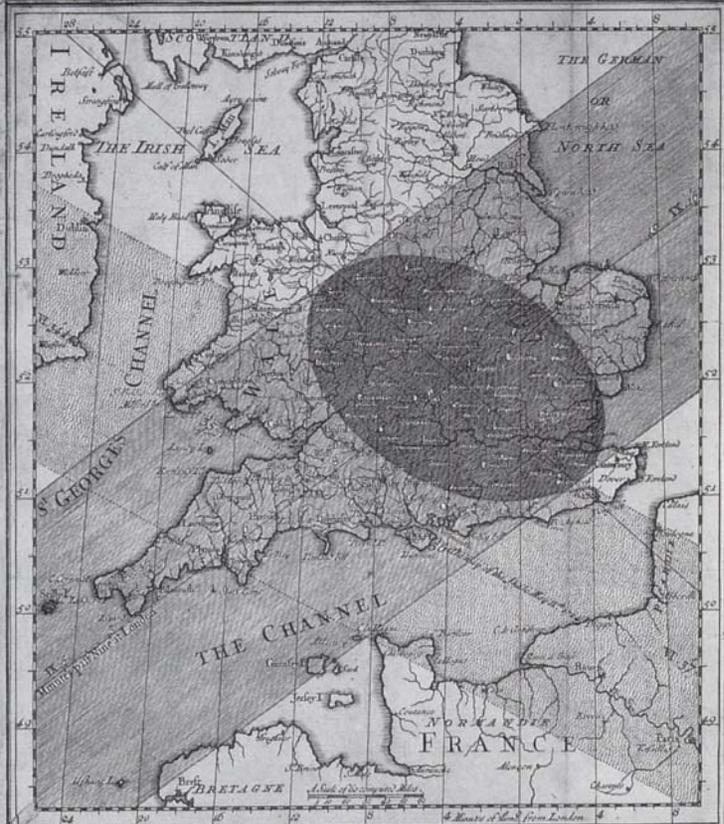
will be totally darkned, but for less Time, as you are nearer those Limits, and are represented in the Scheme, passing on the side near Chelster Lead, and York, and on the other by Chelchester, Gravesend, and Harwich.

At London we compute the Shade to fall at 12 min. past 9 in the Morning when its duration whether it will be a total Eclipse or no London being so near the Southern Limit. The first beginning will be there at 9 min. past Eight and last at 12 min. past Ten. The Oval figure shows the passage of the Shade will take up about 1/3 of the Middle at London, and its Center will pass on the Eastward with a Velocity of nearly 1/2 Geographical Miles in a min. of Time.

The Figures are directed to Observe it, and especially the duration of total Darkness, with all the care they can, for thereby the Situation and dimensions of the Shade, will be nearly determin'd, and by means thereof we may be enabled to predict the like Appearances for the future, to a greater degree of certainty than can be pretended to at present, for want of such Observations.

By their humble servant Edmund Halley

A Description of the Passage of the Shadow of the Moon over England, In the Total Eclipse of the Sun on the 11<sup>th</sup> Day of May 1724 in the Evening, Together with the Passage of the Shadow as it was Observed in the last total Eclipse of 1715. By W. F. Halley, R.S.S. Astr. Roy.



Since the Publication of our Predictions of this Eclipse has had the desired effect, and many curious Persons have been excited thereby to communicate their Observations from most parts of the Kingdom, we thought it might not be unacceptable to replicate after the same manner the passage of the Shade, as it really happened, whereby it will appear that the true Numbers pretend not to be altogether perfect, yet the correction they need is very small.

At London the Eclipse was carefully Observed to begin at 8. 6 min. and to become total at 9. 9. It continued total 3. 23, and ended at 12. 21. And by the Accounts we have received from Abroad the Center of the Shade pass nearly over Plymouth, Exeter, Buckingham, and Huntingdon, leaving Bath and Lynn a little on the left, and Oxford and Ely on the right. The Southern Limit pass over Cranbrook in Kent, leaving Newcastle and Canterbury every little without. And the Northern Limit entered on the Coast of Wales in St. David's Bay, & left England near Flamborough-head, all which the Map more particularly directs. The greater diameter of the Shade having been exactly 11 Miles 1/2, and its lesser 6.

The Numbers on the middle parallel lines in our former, denote the place of the Center of the Shade at so many minutes past Nine at London. By help of this kind of the Center diameter of the Shade's Oval figure is to be on the Center moved passing every place where the greatest Obscurity was seen some instant as at London we may very nearly find the time of the greatest darkness at any other place in 2 Days. For drawing a line parallel to the respective diameter that is proposed, it will give the time of the Shade at 6 minutes of greatest Obscurity not only at London, and by allowing of difference of Meridians, at 6 place still. Thus for example, the greatest Eclipse will be found at York at 9. 15, at Dublin 8. 45, at Bristol 8. 43. And in the same manner may the time of total Darkness be had, by drawing a line parallel to the way of the Shade by 6 these proposals. For as much of the line as falls within the shadow's Oval, measured on the scale of minutes, will show how long that place continued within the true Shade's shadow.

We have likewise thought fit that it should be seen over the whole of England in 2 Eclipses, it will be about 1724 May 11. That is in the Northern Hemisphere very near Dublin & Oxford. But it will pass near London when it begins at 5. 34 of greatest at 6. 18 & ends at 12. 21 in the Evening.

Edmund Halley's maps of the paths of the solar eclipses of 3 May 1715 and 22 May 1724



## Jean-Dominique Cassini (1625-1712)

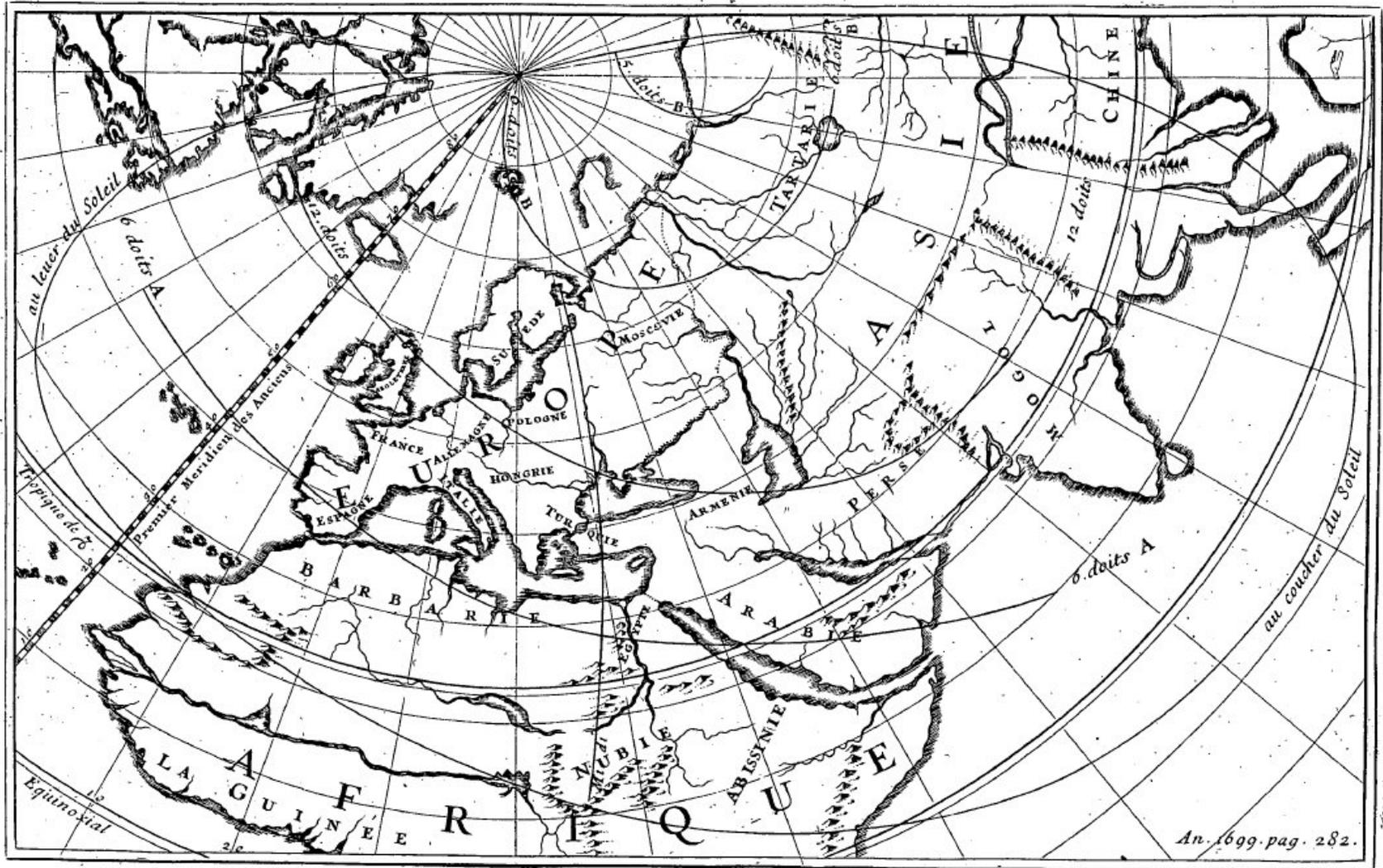
According to Otto Neugebauer (*A History of Ancient Mathematical Astronomy*, 1975, p. 1093):

*“The idea of investigating the total path of a solar eclipse [...] is of modern origin – probably developed in the time of J. Cassini under the influence of the great theoretical interest of the Venus transits of 1761 and 1769. [...] According to Lalande (Astron. II, p. 358, No. 1799; Bibl., p. 256, 1644 [read 1664]) Dom. Cassini constructed in 1664 for the first time the path of a solar eclipse (visible in Ferrara) on a terrestrial map. But there was no total solar eclipse in 1664 and no publication of Cassini with the title quoted by Lalande seems to be known.”*

Entry in Lalande’s *Bibliographie astronomique* (1802):

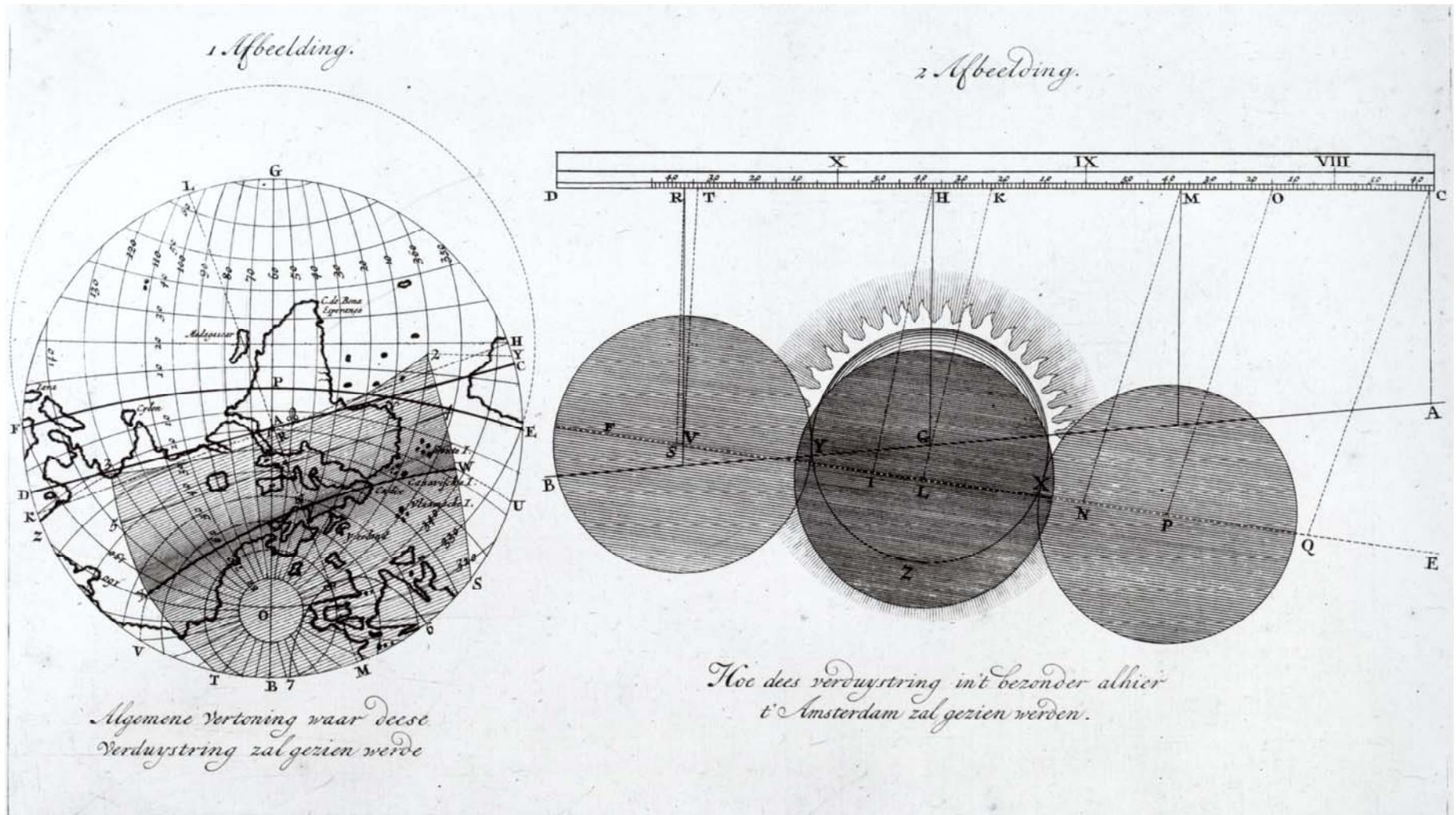
*“Ferrarae, in-fol. Jo. Domenici Cassini Osservazione del eclisse solare fatta in Ferrara l’anno 1664, con una figura intagliata in rame, che rapresenta uno nuovo metodo di trovar l’apparenze varie che fa nel medesimo tempo in tutta la terra. Weidler, p. 527. = Astron. art. 1808.”*

The earliest retrospective eclipse map (solar eclipse of 23 September 1699)



Published in J.D. Cassini, "Reflexions sur l'eclipse du 23. Septembre 1699. qui ont été omises dans leur place", *Histoire de l'Académie Royale des Sciences avec les mémoires de mathématique & de physique tirez des registres de cette Académie pour l'année MDCXCIX* (Paris, 1700).

The earliest predictive eclipse map (solar eclipse of 11 May 1706)



Symon van de Moolen's diagram on the solar eclipse of 11 May 1706 from a Dutch booklet published in 1705

The solar eclipse of 12 May 1706 according to a pamphlet prepared by Andreas van Luchtenburg, a teacher of mathematics and navigation at various schools in Rotterdam and in Amsterdam, and published shortly before the event.



**NIEUWE WERELD KAART, van niemant voor dezen alzo gezien noch bekend;**

Met een noot zodanige getelde Vertooning op eenige Kaart, wgens deze nieuwe eerkontdekte Landen ten Oolten van Afrika, en ten Welten van America; intagsden der A overlimmentende Zon-Eclips dezer Jaar 1706 op den 11 May waer Tijd en Stijl, of 12 valliche Stijl, welke loopen over't midden van Europa en Asia, van den Welten tot den Oolten, alwaar de Zon gantelich zal verduillieren, in duyzenden van Steden en Dorpen, tot verwoederinge en verbaathheid van alle Aandhouwers, alsoe den dag aldaar als in een rijck zal veranderen, zo verre dat men in sommige Landen en Strecken de sterren do Hench sal kunnen zien. Dit is dan een Algemeen Proef-look van den Waren Hemel-Loop, boven alle die voor dezen gewest zijn.

Door den Mathematicus **ANDREAS** van **LUCHTENBURG**, Met Oitry van de **Ed. Groot Mog. HEEREN** Staten van dezes Lande.

Opgedragen aan de **Ed. Gr. Agth. HEEREN** Regeerende Burgermeesters der **STAD ROTTERDAM**: **Dr. HEEREN**, **Mr. W. van Hoogvliet**, **A. Quaedam**, **J. van Belle**, **G. Coillander**.

**WY**N HEEREN; hier oeffen wy U Ed. Groot Agth. dit noot gezien werkie op, om't zeek ook onder U Ed. Groot Agth. vermoegende Vrengelen en befehmeringe aan de ganteliche Wereld over te geven, tot verwoederinge van dezes, gemerkt men zalke in alle voorederige Tijden niet heeft geweten nog gezien. Eerst hoe de Menschen in America, en dertich onbegrijpde Rycken gekomen mogen wesen. Sommige hebben gemeend dat d'Americanen met de triandren van deen, moesten zoudt zijaal-oud, als een geplagte wesen; Adam ge worch, onder welken dat de Socondelooke America niet zoudt overloopen moggen wesen. Sommige hebben gemeend dat d'Americanen met de triandren van deen, moesten zoudt zijaal-oud, als een geplagte wesen; Adam ge worch, onder welken dat de Socondelooke America niet zoudt overloopen moggen wesen. Sommige hebben gemeend dat d'Americanen met de triandren van deen, moesten zoudt zijaal-oud, als een geplagte wesen; Adam ge worch, onder welken dat de Socondelooke America niet zoudt overloopen moggen wesen.

**E**D. GROOT AGTH. HEEREN: In deze nieuwe Kaart, die we hoopent dat een groter weck te brengen, ook in Hemellicke en Aardelike Globen, werd hier vercoont door de Linie A B C: loopende door't midden van Europa en Asia, van den Welten tot den Oolten, hoe de Zon op den 11 Mey waer Tijd en Stijl, of 12 valliche Stijl, welke loopen over't midden van Europa en Asia, van den Welten tot den Oolten, alwaar de Zon gantelich zal verduillieren, in duyzenden van Steden en Dorpen, tot verwoederinge en verbaathheid van alle Aandhouwers, alsoe den dag aldaar als in een rijck zal veranderen, zo verre dat men in sommige Landen en Strecken de sterren do Hench sal kunnen zien. Dit is dan een Algemeen Proef-look van den Waren Hemel-Loop, boven alle die voor dezen gewest zijn.

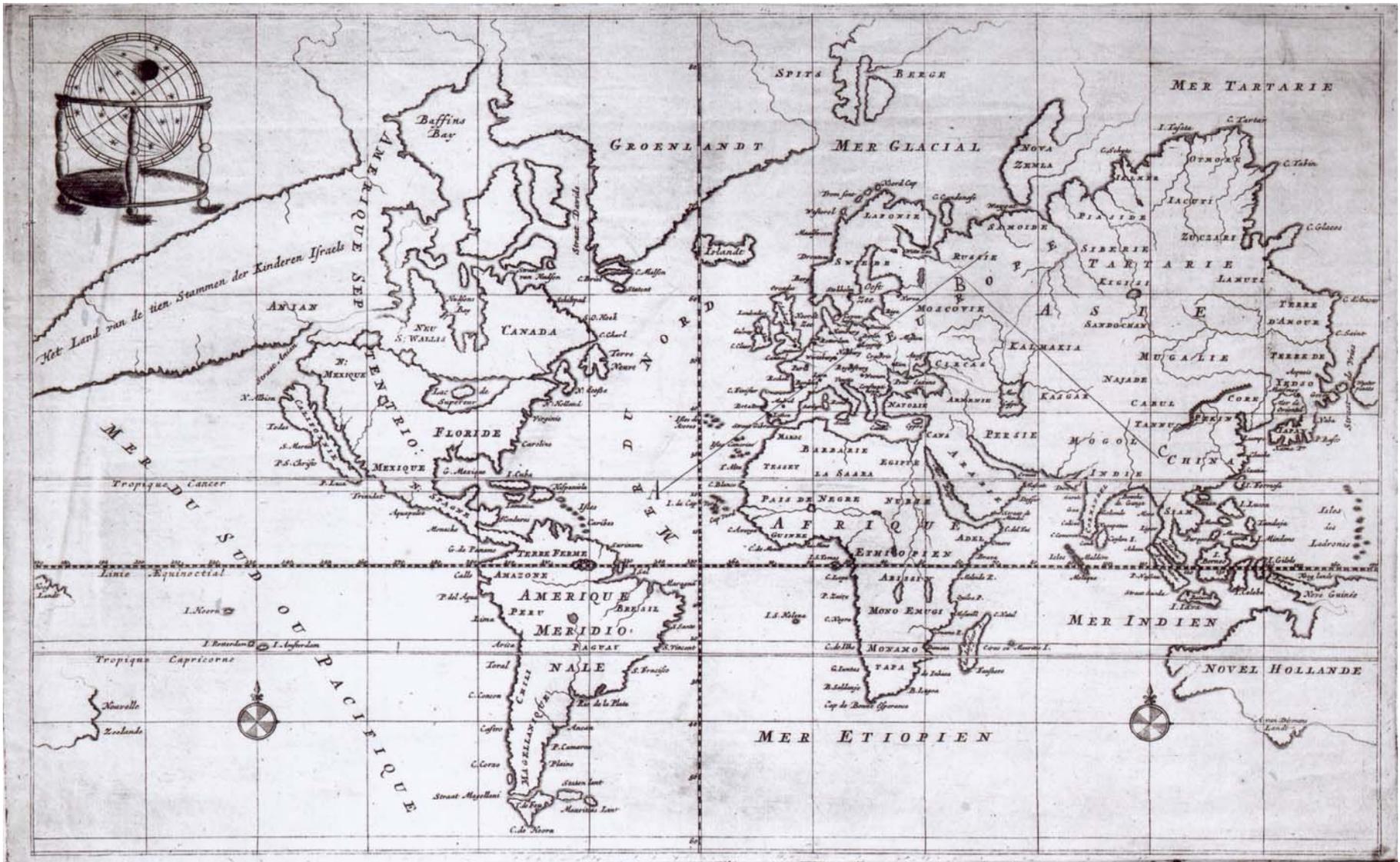
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Hier volgt een verwoederinge en verbaathheid van alle Aandhouwers, alsoe den dag aldaar als in een rijck zal veranderen, zo verre dat men in sommige Landen en Strecken de sterren do Hench sal kunnen zien. Dit is dan een Algemeen Proef-look van den Waren Hemel-Loop, boven alle die voor dezen gewest zijn.

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*Andreas van Luchtenburg*



Approximate path of the solar eclipse of 12 May 1706 according to Andreas van Luchtenburg. The eclipse is assumed to start in the Atlantic Ocean (A), reach its northernmost point above Moscow (B) and to end in China (C).





IOHANN GABRIEL DOPPELMAIR.  
*Mathem. Prof. Publ. Noriberg Acad.,  
Imperial Leopoldino-Carolinae Na-  
turae curios. ut et Societ. Reg. Borus. Scient.  
Sodalit.*

## Johann Gabriel Doppelmayr (1677- 1750)

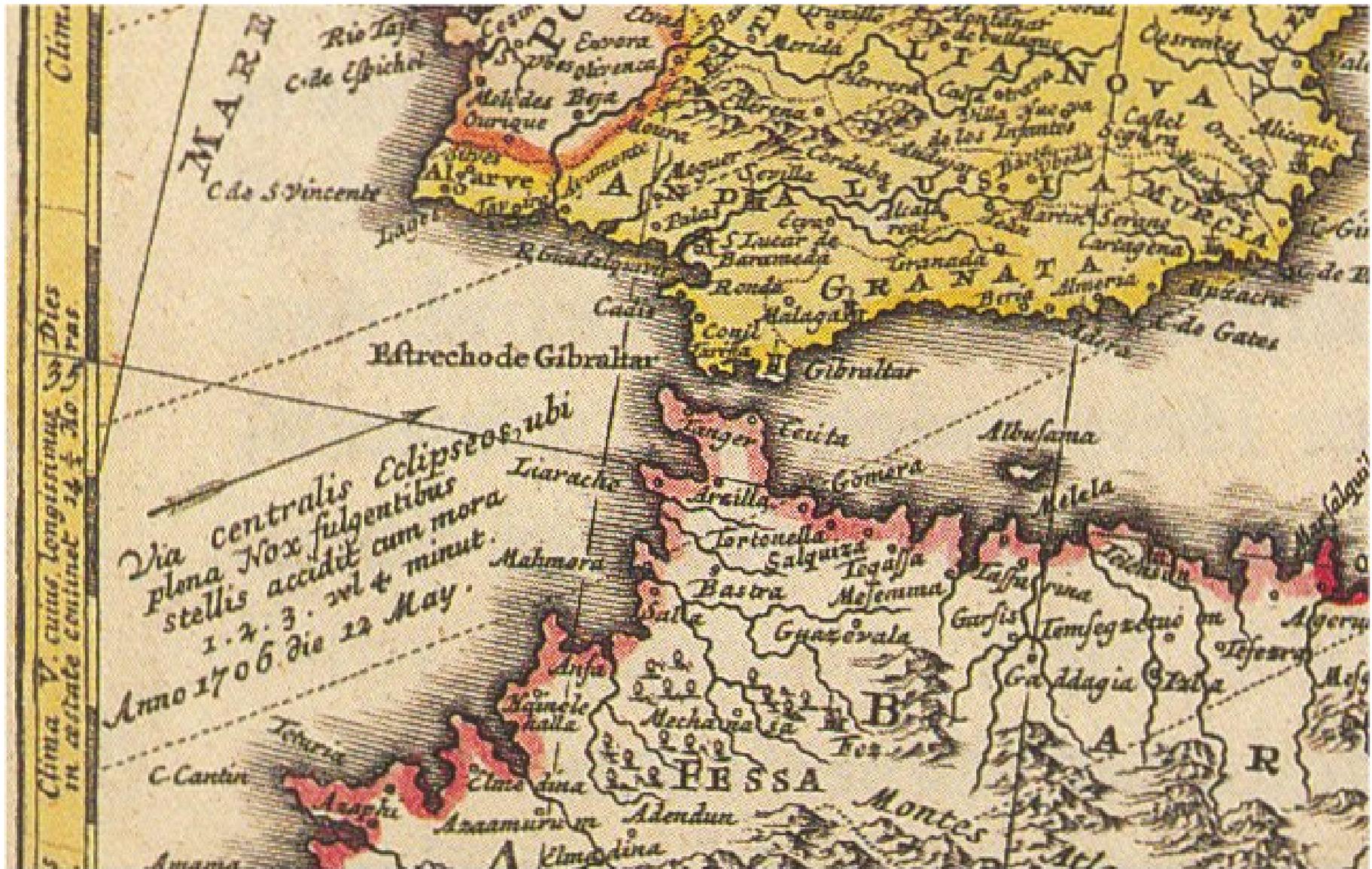
Native of Nuremberg where he lived and worked during most of his life.

- Visited Holland during 1700/1701 (Utrecht).
- Visited England (London, Oxford) in the summer of 1701.
- Returned to Holland to learn lens grinding in Leiden (1701/1702).

Designed many astronomical diagrams and maps for the Nuremberg publisher Johann Baptista Homann (1664-1724). Many of these were later published in his *Atlas Coelestis* (Nuremberg, 1742) and *Atlas Novus Coelestis* (Nuremberg, after 1742).



Doppelmayr's map of Europe (published in early 1707) depicting the circumstances of the solar eclipse of 12 May 1706 as observed by various astronomers ("*multis illustrium virorum*")



Detail from Doppelmayr's map of Europe with the totality zone of the solar eclipse of 12 May 1706

Geographica Repraesentatio

EUROPÆ die 12. Maji 1706 ECLIPSATA

per phaſium Solis (in 12 digitos diviſi) magnitudines quævis, ſuis locis appa-  
rentes, cum via totalis Umbrae, ex multis Illuſtrium Virorum obſervationibus  
indiquaque collectis, per arcus parallelos op̄i D<sup>ni</sup> J. GABR. DOFFELMAYR  
H. ab. P. curioſe ſtenduntur Auctore J. B. Homanno, ut infra.

Zu bemerken

Daß aus dem hieby geſetzten Obſervationibus die Eintheilung dieſer Kunſternus-Carten  
gemacht worden ſeyt, u. ſt die Bedeckung der Sonne an folgenden Orten groß beſundt worden  
Dawer nach dem Zeit-Minuten

PARTIAL nach den ecliptiſchen Zellen.

Zu Barcelona	....	Zu Paris	10 $\frac{1}{2}$ .
Arles	....	Strasßburg	11 $\frac{1}{2}$ .
Zürch	4.	Rom	10 $\frac{1}{2}$ .
Schaffhaufen	....	Bononia	11 $\frac{1}{2}$ .
Eln	4	Genua	11 $\frac{1}{2}$ .
Neuburg	5 $\frac{1}{2}$ .	Jena	11 $\frac{1}{2}$ .
Fürnberg	2 $\frac{1}{2}$ .	Leipzig	11 $\frac{1}{2}$ .
Leitz	0 $\frac{1}{2}$ .	Berlin	11 $\frac{1}{2}$ .
Breßlau	1.	Leiden	10 $\frac{1}{2}$ .
Königsberg	....	Canterbury	10.

CIRCULUS

Detail from Doppelmayr's map of Europe with observations of the solar eclipse of 12 May 1706

# ATLAS NOVVS COELESTIS

*Muski* IN QVO *Astronomii* *Francia* 1777.

## MVNDVS SPECTABILIS,

ET IN EODEM

TAM ERRANTIVM QVAM INERRANTIVM STELLARVM  
**PHOENOMENA NOTABILIA,**  
CIRCA IPSARVM LVMEN, FIGVRAM, FACIEM, MOTVM, ECLI-  
PSES, OCCVLTATIONES, TRANSITVS, MAGNITVDINES, DISTAN-  
TIAS, ALIAQVE  
SECVNDVM

**NIC. COPERNICI**

ET EX PARTE

**TYCHONIS DE BRAHE**

HIPOTHESIN,

NOSTRI INTUITU, SPECIALITER, RESPECTU VERO AD AP-  
PARENTIAS PLANETARVM INDAGATV POSSIBILES, E PLANETIS PRI-  
MARIIS, ET E LUNA HABITO, GENERALITER,

*E CELEBRIMORVM ASTRONOMORVM OBSERVATIONIBVS  
GRAPHICE DESCRIPTA EXHIBENTVR*

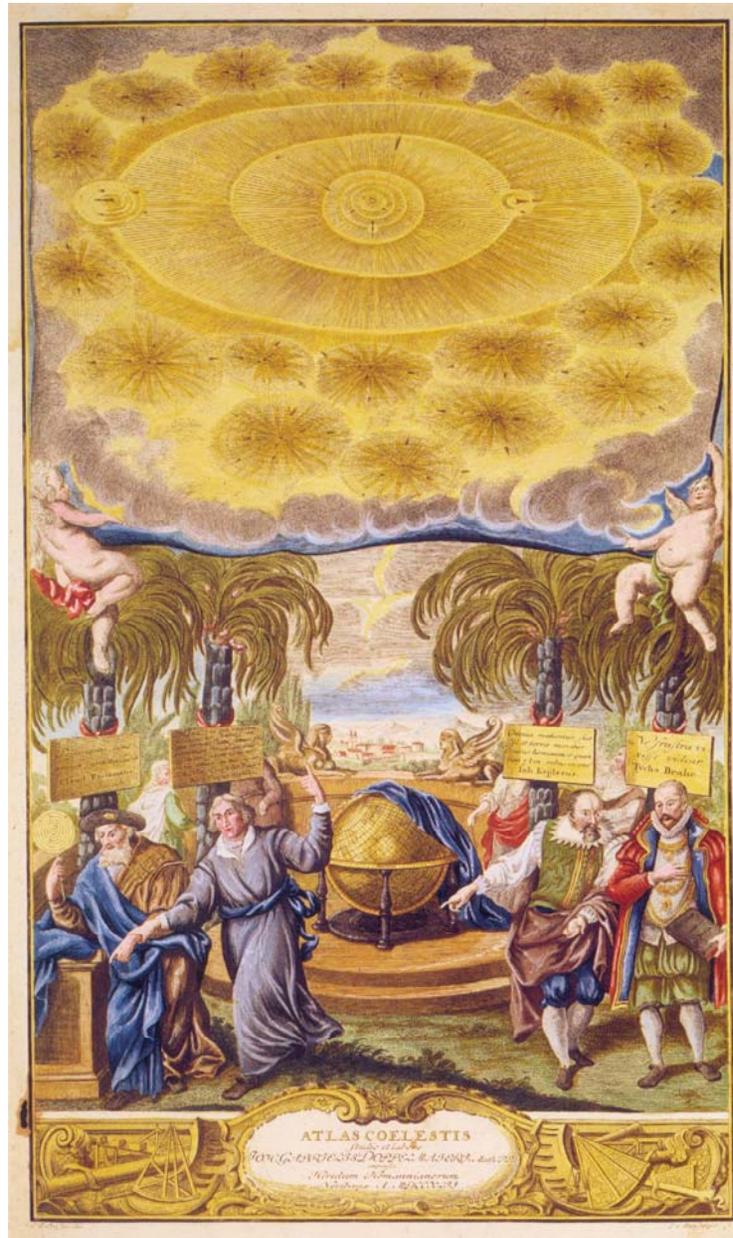
**IOH. GABRIELE DOPPELMAIERO.**

ACADEMIARVM IMP. LEOPOLDINO-CAROLINAE ET PETRO-  
POLITANE, SOCIETATVMQVE REGG. SCIENTIARVM, BRITANNICAE ET  
BORVSSICAE, SODALI, NEC NON PROFESSORE PVBL. MATHEMA-  
TVM NORIM.



NORIMBERGAE,

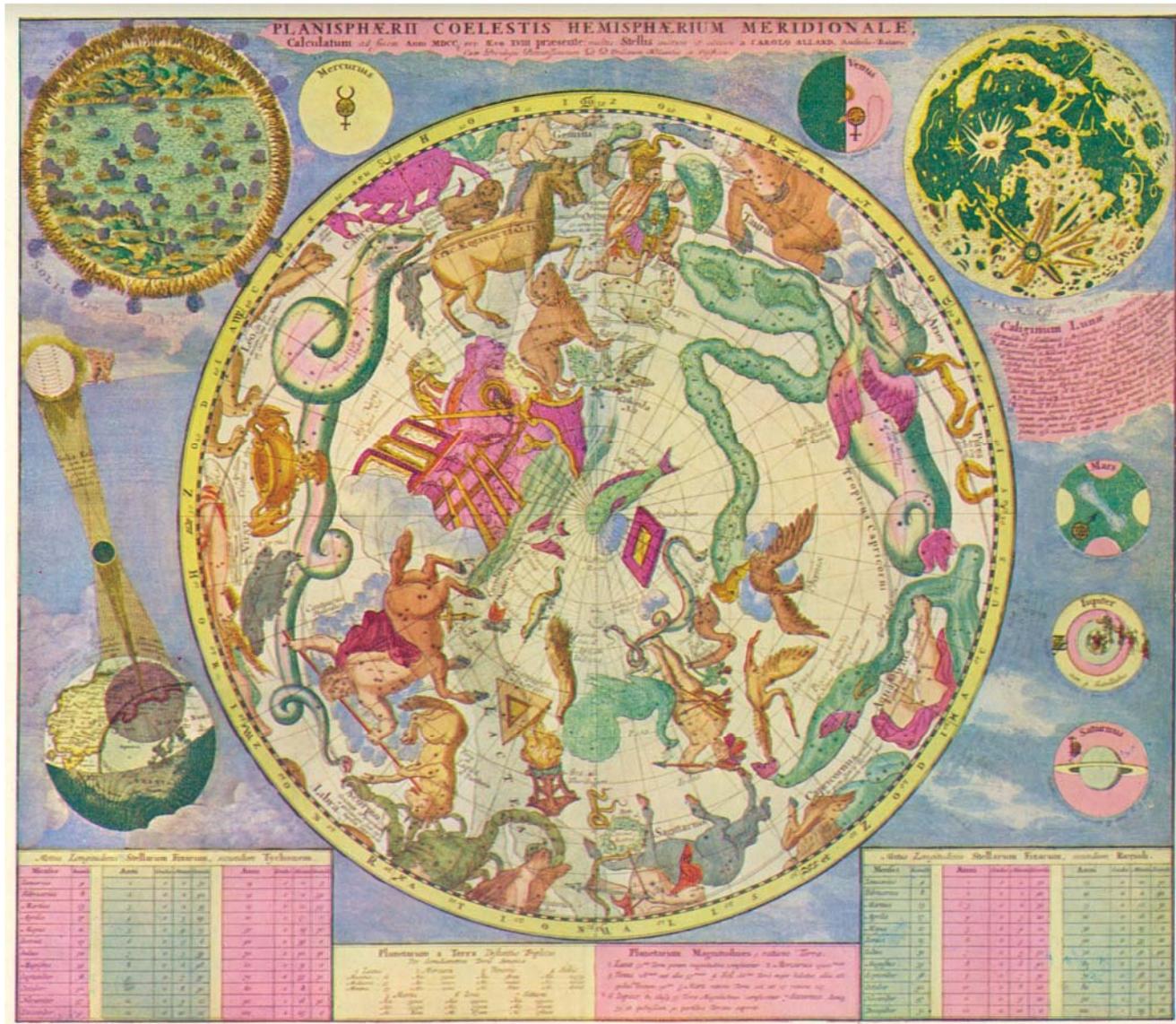
Sumptibus Heredum Homannianorum. A. 1742.



Doppelmayr's *Atlas Novus Coelestis* (Nuremberg, after 1742)







**Carel Allard (1648-1709) – astronomical map depicting the southern celestial hemisphere (1708)**  
 Note the solar eclipse diagram and its similarity with Doppelmayr's diagram

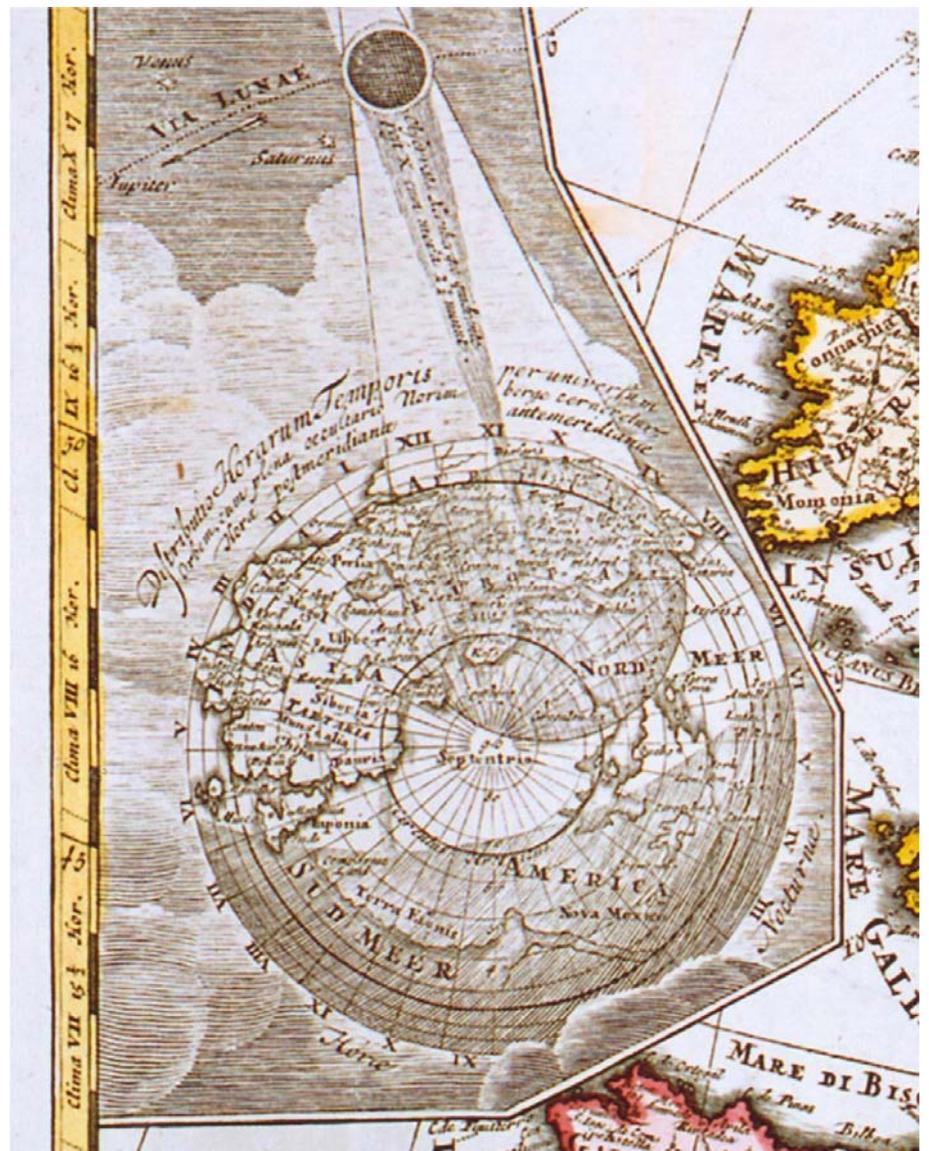
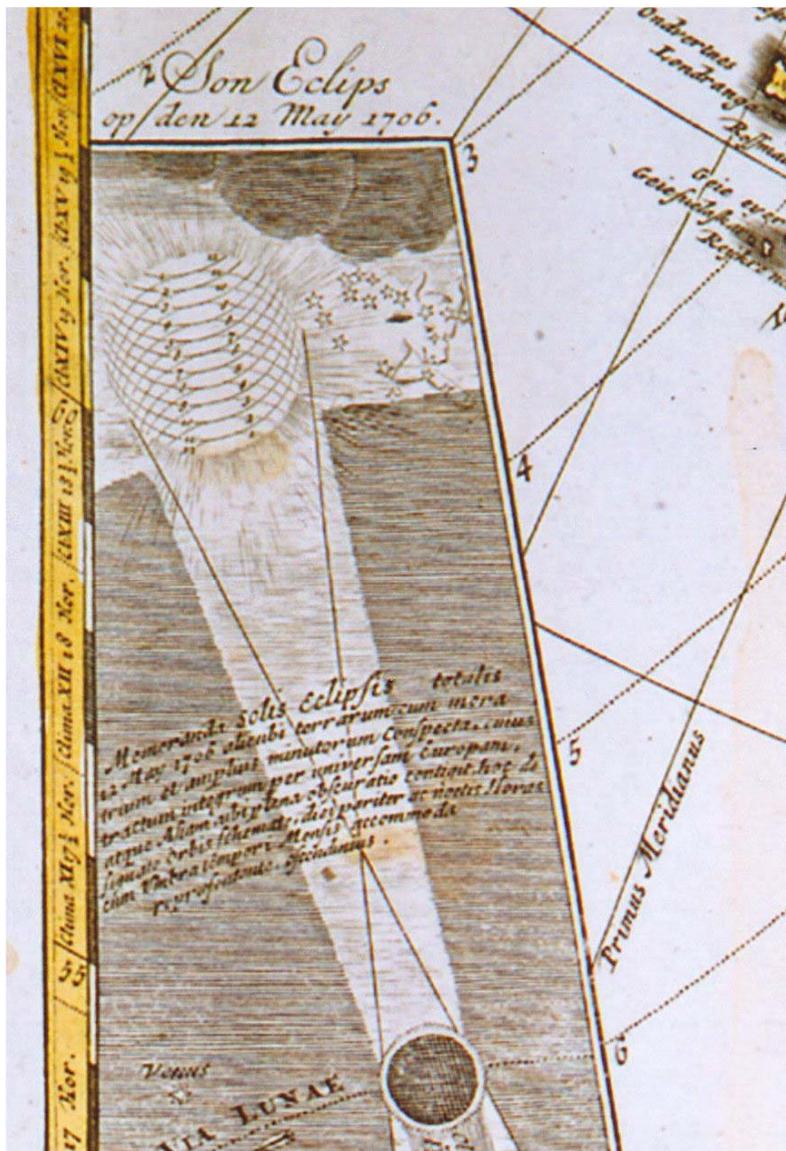
ECLIPSE SOLIS TOTALIS cum mora, d. 12 Maji 1706, horis autem, in EUROPA celebris. Geographica Representatio, in qua CENTRALIS UMBRE TRACTUS ac reliquae Magnitudines suis locis competentes, ex Illustrum Virorum observationibus deductae, per arcus parallelorum, etaeq; longitudinum, indicatae. Opus J. G. Doppelmayr, Astronomi Regii, et Mathematici, a PETRO SCHENK, cum privilegio, Aedifici et Regis Delincentis.



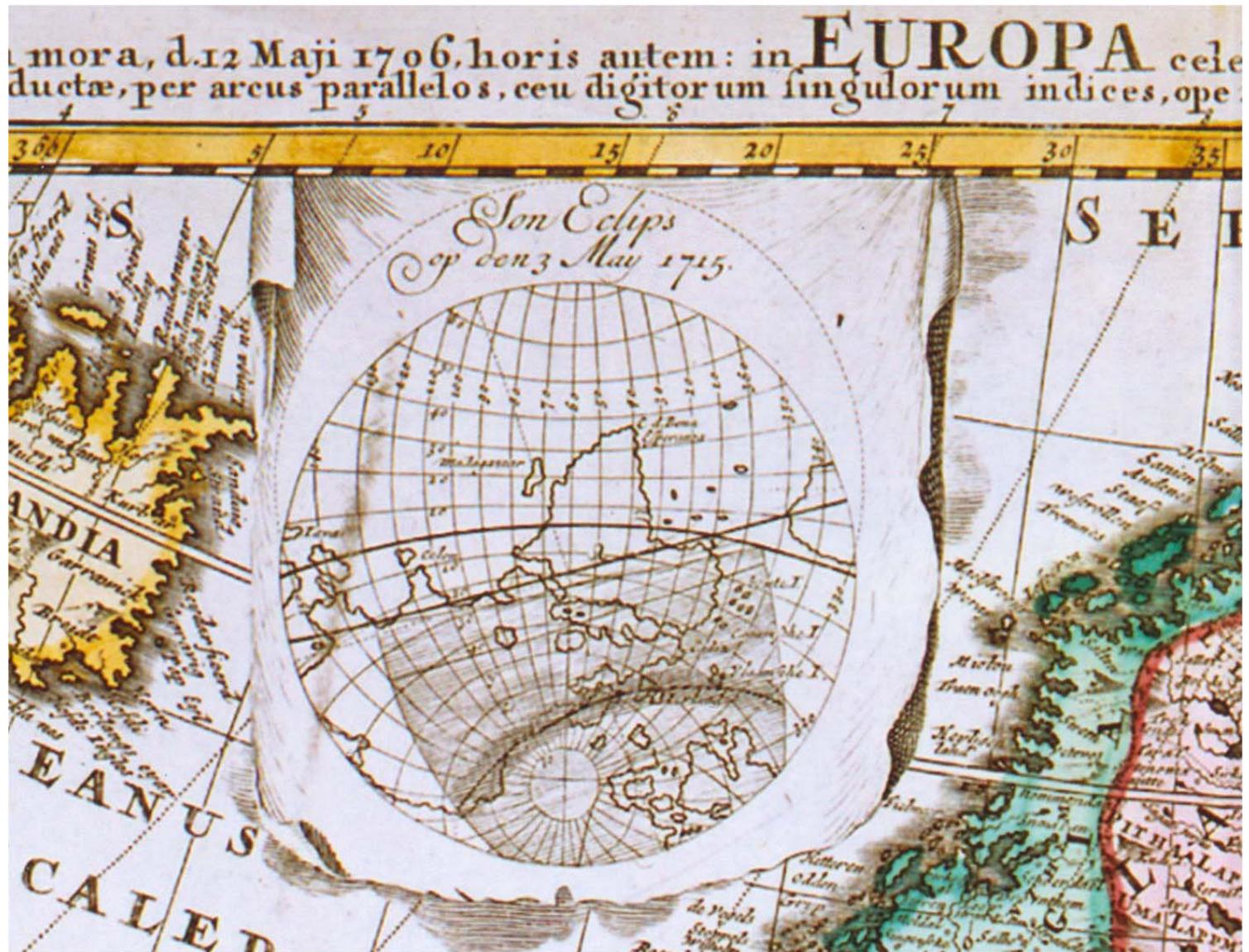
**Petrus Schenk jr. (1693-1775) – map published around 1715 depicting the solar eclipses of 12 May 1706 and 3 May 1715, compiled from the data of Johann Gabriel Doppelmayr and Symon van de Moolen**



Detail from the Schenk map with the path of totality of the solar eclipse of 12 May 1706

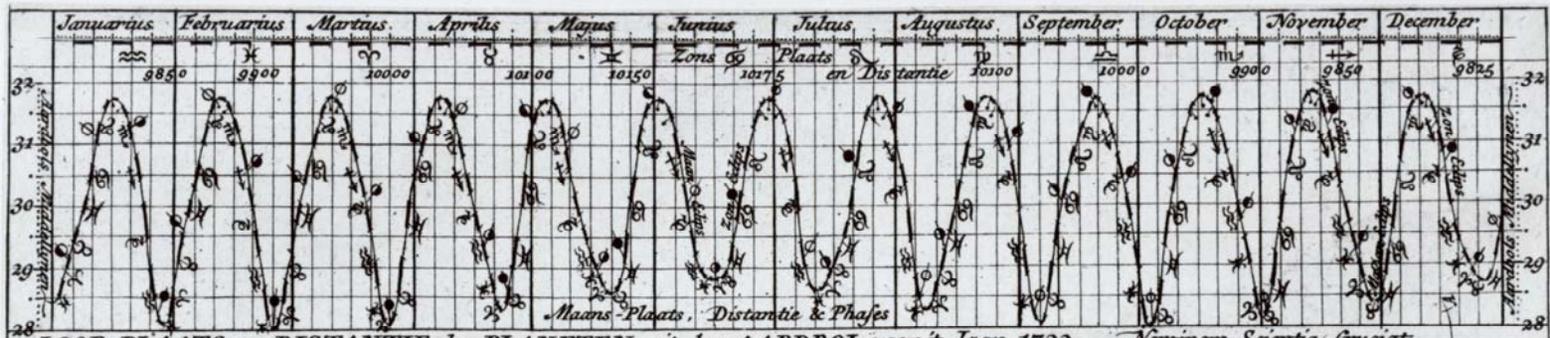


**Diagram from the Schenk map depicting the geometry of the solar eclipse of 12 May 1706 (after Doppelmayr)**

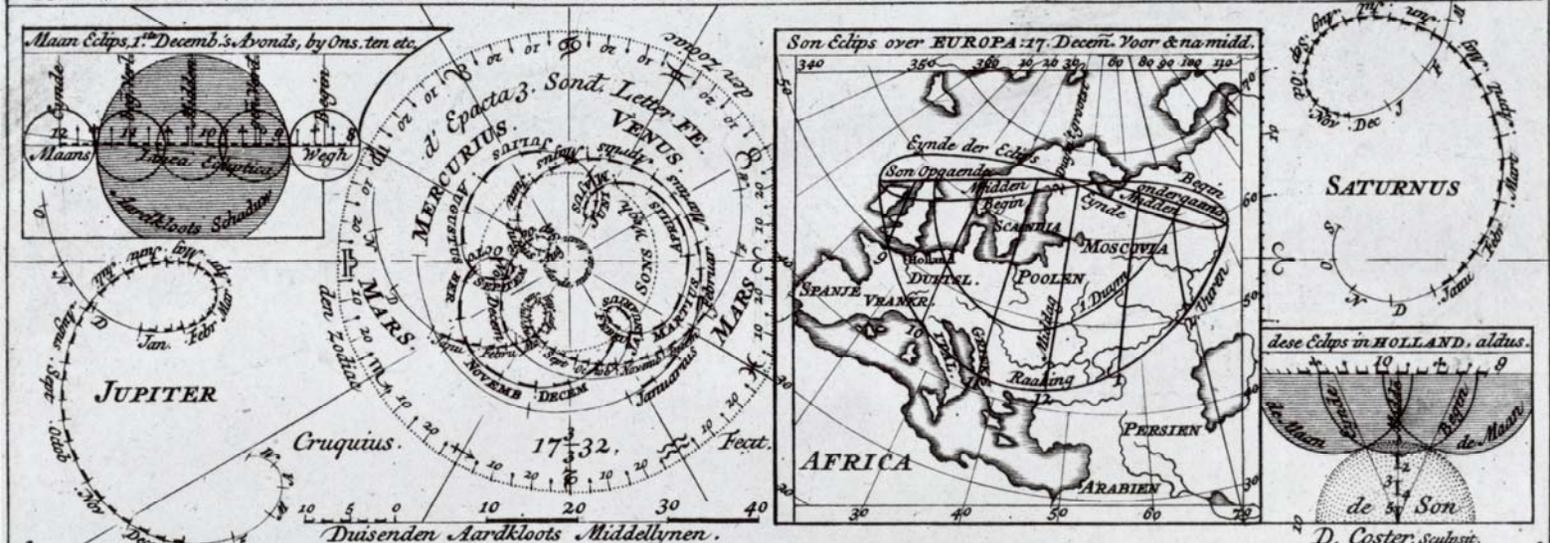


**Diagram from the Schenk map depicting the solar eclipse of 3 May 1715  
 (after Symon van de Moolen)**

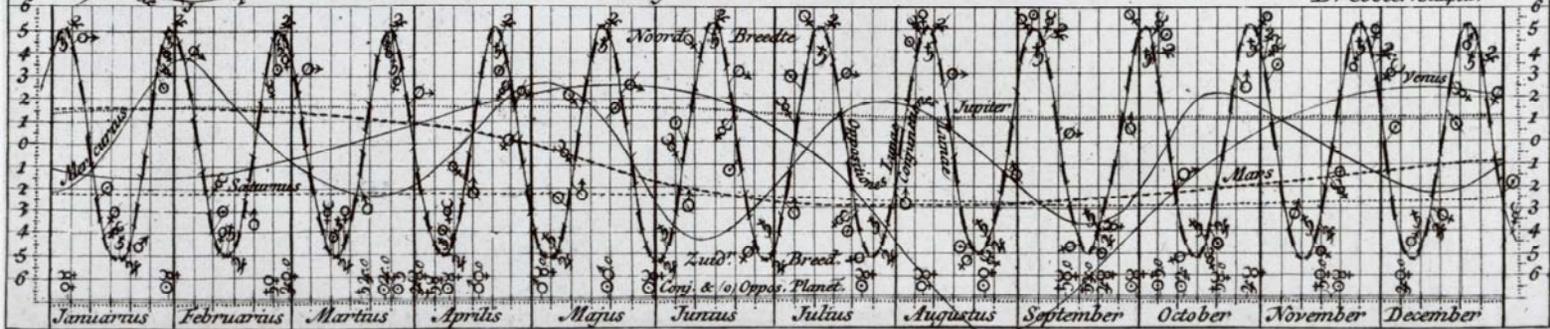




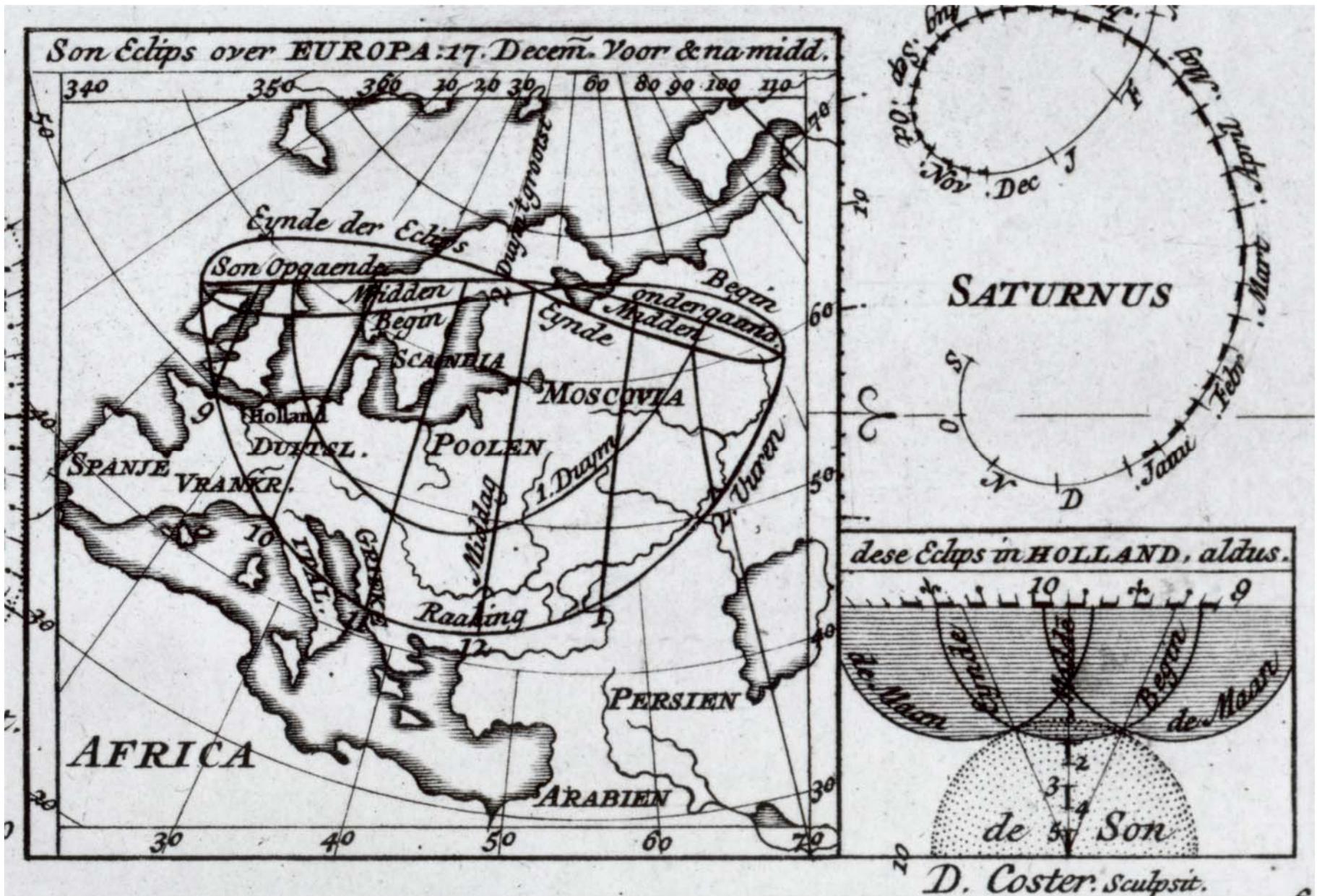
LOOP, PLAATS, en DISTANTIE der PLANETEN, uit den AARDBOL voor 't Jaar 1732. Neminem Scientia Cruciat.



D. Coster. sculpit.

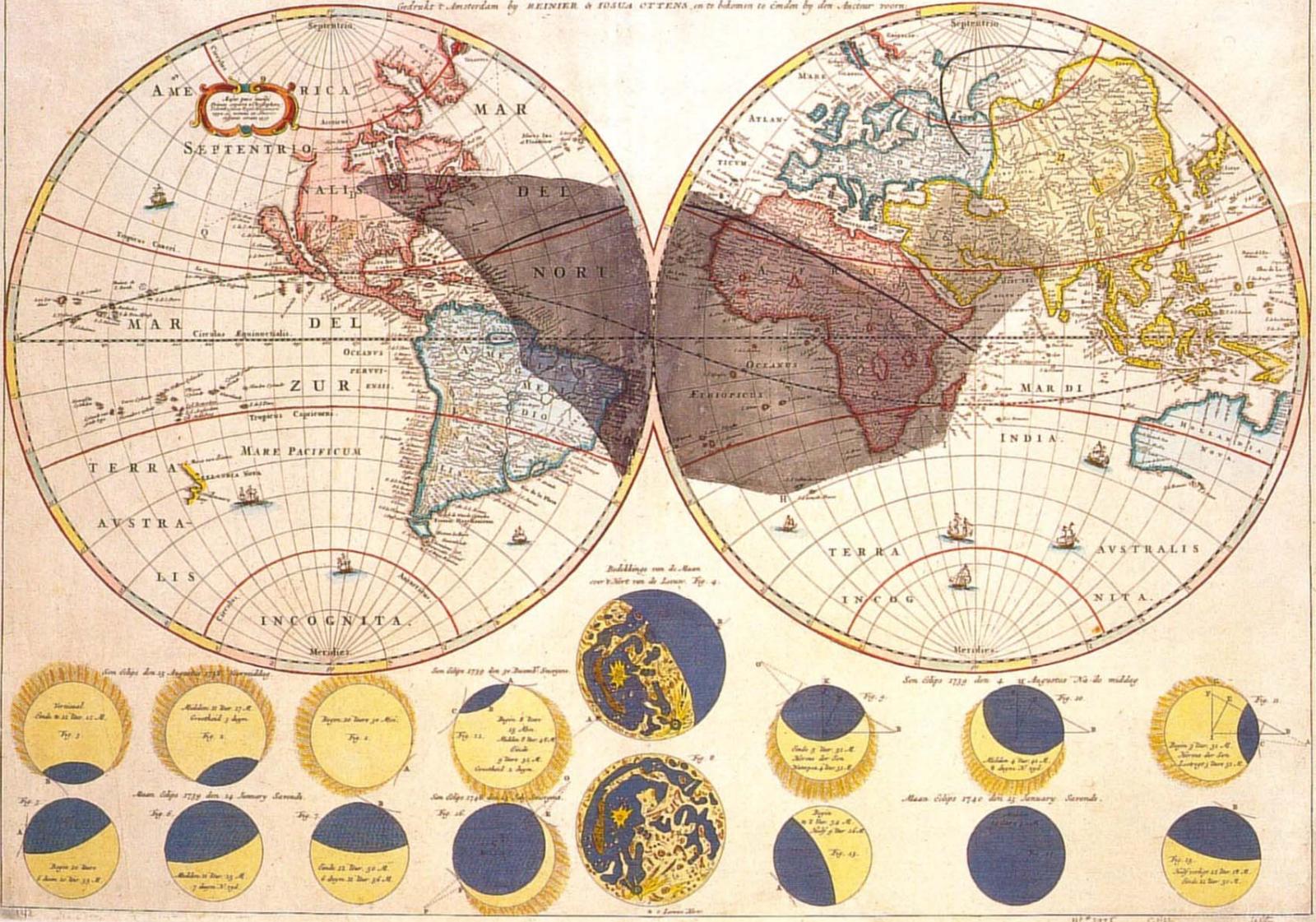


Nicolaus Samuel Cruquius (1678-1754) – diagram of the astronomical phenomena of 1732



Detail depicting the circumstances of the solar eclipse of 17 December 1732

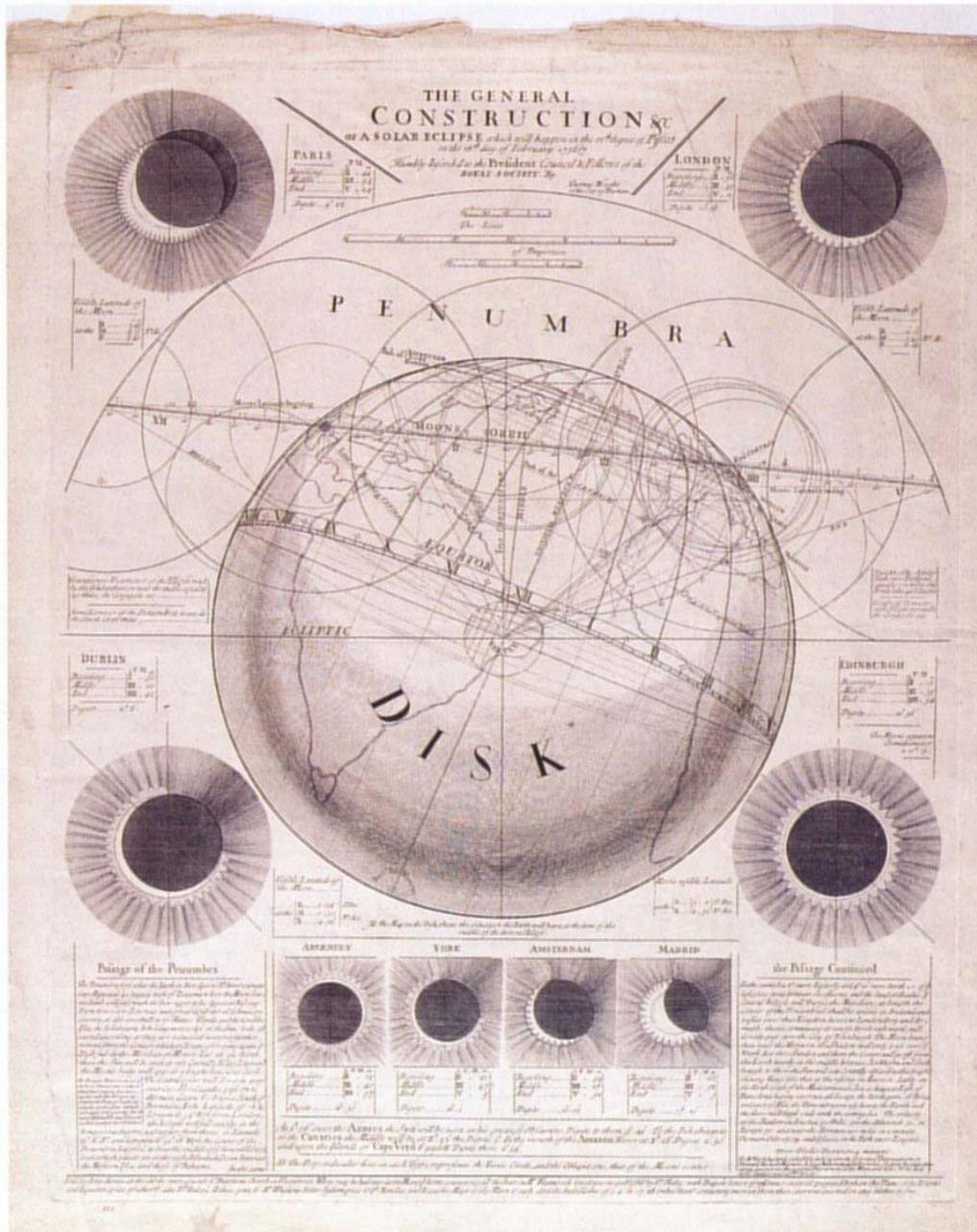
*ASTRONOMISCHE HEMEL SPIEGEL* waar in men sien kan de merkwaardigste hemelsche verschynselen aan Son, Maan, en Sterren, hoe dezelve zij na de ware justitie tot AMSTERDAM, en omleggende Steden zullen vertonen, sijnkende get. het Jaar 1740. naar by gevoegt is de vertoning van een groote Sons verduistering in t. Jaar 1748. Alles tot voorplanting der Astronomie en dienst der Liefhebbers van de Wis-kunst, in t. Licht gegeven door SYMON PANSEK Stads-Mathematicus, leraar van de Wis-kunst en Astronomie tot EMBDEN.  
 Gedrukt t. Amsterdam by BEINER & JOHANN OTTENA, en te bekomen te vinden by den Aucteur woon.



**Symon Panser of Embden (1699-1754) – solar eclipses of 15 August 1738 and 4 August 1739**



Robert Sayer (1725-1793/94) - solar eclipses of 1715, 1724, 1737, 1748 and 1764



**Thomas Wright of Durham (1711-1786) – solar eclipse of 1 March 1737**

## Further reading:

- Geoff Armitage, *The Shadow of the Moon: British Solar Eclipse Mapping in the Eighteenth Century* (Map Collector Publications, Tring, 1997).
- Jay M. Pasachoff, “Halley as an Eclipse Pioneer: His Maps and Observations of the Total Solar Eclipses of 1715 and 1724”, *Journal of Astronomical History and Heritage*, vol. 2 (1999), pp. 39-54.
- Eli Maor, “Mapping the Moon’s Shadow”, *Sky & Telescope*, vol. 108 (2004), nr. 6, pp. 42-49.
- Robert H. van Gent, “Mapping the Lunar Shadow: The Earliest Solar Eclipse Maps”, in: G. Wolfschmidt & A.D. Wittmann (eds.), *Development of Solar Research* (Hamburg University Press, Hamburg, 2005 [= *Nuncius Hamburgensis: Beiträge zur Geschichte der Naturwissenschaften*, Band 2) – in press.